ART 34 AMDT

Claims

1. MR imaging method for the imaging and determination of the position of a unfoldable medical device inserted in an examination object, in particular of a vena cava filter or of a balloon catheter, whereby

a) the examination object is arranged in an external magnetic field,

b) by means of application of high-frequency radiation of a specific resonance frequency, transitions between spin energy levels of the atomic nuclei of the examination object are excited and

c) MR signals thus produced are detected as signal responses, evaluated, and imaged in spatial resolution,

characterized

in that, in a locally defined area inside and/or outside the device, a changed signal response of the examination object is produced whereby the device has or forms at least one passive resonance circuit with an inductance and a capacitance whereby their resonance frequency is essentially equal to the resonance frequency of the applied high-frequency radiation, whereby an unfoldable part of the device forms the inductance or is integrated therein, this unfoldable part is unfolded after insertion of the device in the examination object and the area is imaged with the changed signal response in spatial resolution.

2. Method according to Claim 1, **characterized in** that the application of the high-frequency radiation excites the resonance circuit and thus an amplified excitation of the nuclear spins of the examination object results in the locally defined area.

3. Method according to Claim 2, **characterized in** that the locally defined area where an amplification of the excitation of the nuclear spins takes place is located in a compartment formed within the device and surrounded by the inductance.

4. Method according to Claim 2, **characterized in** that the locally defined area where an amplification of the excitation of the nuclear spins takes place is outside the device and adjacent thereto, whereby at least one resonance circuit is arranged on the surface of the device such that with the application of high-frequency radiation the magnetic flow in the adjacent area observed is amplified.

5. Method according to Claim 1, **characterized in** that with the application of the high-frequency radiation the resonance circuit becomes detuned or the capacitance is short circuited to the extent that no amplified excitation of the nuclear spins takes place in the locally defined area, whereas by measuring of the signal response of the locally defined

area the detuning of the resonance circuit or the short circuiting of the capacitance is canceled, thus resulting in a change in the signal response.

6. Method according to at least one of the preceding claims, **characterized in** that the resonance circuit is adjusted to the resonance frequency by unfolding of the device after insertion of the device into the examination object.

7. Method according to to at least one of the preceding claims, **characterized in** that the inductance and/or the capacitance are adjusted for the resonant tuning of the resonance circuit.

8. Method according to at least one of the preceding claims, **characterized in** that at least two resonance circuits formed or arranged on the device are used, whereby the coils of the respective inductances are arranged differently, in particular aligned vertically to each other or behind each other.

9. Unfoldable medical device, in particular a vena cava filter (17) or of a balloon catheter (12),

characterized

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by at least one passive resonance circuit with an inductance (22a, 22b, 25a, 25b) and a capacitance (32a, 32b, 35a, 35b), whose resonance frequency is essentially equal to the resonance frequency of the applied high-frequency radiation of an MR imaging system, whereby an unfoldable part of the device forms the inductance (22a, 22b, 25a, 25b) or the inductance (22a, 22b, 25a, 25b) is integrated into such a part, such that it unfolds along with the device when this is unfolded.

10. Device according to Claim 9, **characterized in** that the inductance (22a, 22b, 25a, 25b) is formed or arranged on the surface of the device.

11. Device according to Claim 9 or 10, **characterized in** that the inductance (22a, 22b, 25a, 25b) is formed by a conductor which runs on the surface of the device.

12. Device according to Claim 11, **characterized in** that the inductance (22a, 22b) is formed on a foil which is adhered to the surface of the device (12).

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13. Device according to Claim 8 or 10, **characterized in** that the inductance (25a, 25b) and/or the capacitance (35a, 35b) are formed from the material of the device (17).

14. Device according to at least one of Claims 9 through 13, **characterized in** that the device (12, 17) is elongated in shape and the coil axis of the inductance (22b, 25b runs substantially parallel to the longitudinal axis of the device (12, 17).

15. Device according to Claim 14, **characterized in** that the inductance is formed by a conductor arranged on the surface of the device in the shape of a single, double or multiple helix.

16. Device according to at least one of Claims 9 through 13, **characterized in** that the device (12, 17) is elongated in shape and the coil axis of the inductance (22a, 25a) runs substantially perpendicular to the longitudinal axis of the device (12, 17).

17. Device according to Claim 16, **characterized in** that the inductance is formed by a spiral-shaped conductor (22a, 25a) formed or arranged on the surface of the device.

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18. Device according to at least one of Claims 9 through 17, **characterized in** that the device has a plurality of resonance circuits with a plurality of inductances, which are preferably arranged vertically relative to each other or arranged behind each other.

19. Device according to at least one of Claims 9 through 18, **characterized in** that the device has means (113) for detuning at least one resonance circuit with the application of high-frequency radiation.

20. Device according to Claim 19, **characterized in** that the means for detuning the at least one resonance circuit are designed such that they switch a condenser (113) parallel to the capacitance (3′) of the resonance circuit with the application of high-frequency radiation.

21. Device according to Claim 19, **characterized in** that the means for detuning the at least one resonance circuit are designed such that they switch a coil (114) parallel to the inductance (2′) of the resonance circuit with the application of high-frequency radiation.

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22. Device according to at least one of Claims 9 through 18, **characterized in** that the device is provided with means (112) for the short circuiting of the capacitance (3') when applying the high-frequency radiation.

23. Device according to Claim 22, **characterized in** that the means for the short circuiting of the capacitance have two diodes (112) which are switched parallel to the capacitance (3').

24. Device according to at least one of Claims 9 through 23, **characterized in** that a switch (10) is provided, by which the at least one resonance circuit can be activated or deactivated.

25. Device according to at least one of Claims 9 through 24, **characterized in** that the inductance (2) and/or the capacitance (3) of the resonance circuit are adjustable for the tuning to the resonance frequency of the MR system.

26. Device according to at least one of Claims 9 through 25, **characterized in** that the resonance circuit (4) has a plurality of parallel or serially switched inductances (2a, 2n) and/or capacitances (3a, 3n).

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27. Device according to at least one of Claims 9 through 26, **characterized in** that the device is a balloon catheter (12), on whose outer skin a spiral-shaped or helix-shaped inductance (22a, 22b) is formed.

28. Device according to Claim 27, **characterized in** that the capacitance (32a, 32b) is realized in the form of parallel conductors which run along the axis (121) of the balloon catheter (12).

29. Device according to at least one of Claims 9 through 26, **characterized in** that the device is a vena cava filter (17) with elongated, movable toothed elements (171), whereby the inductance (25a, 25b) is attached to the toothed elements.

30. Device according to Claim 29, **characterized in** that the inductance (25a, 25b) and/or the capacitance (35a, 35b) are made of the material of the vena cava filter.

31. MR imaging system for performance of the method according to Claim 1, **characterized by** a device according to Claim 7 [?sic].

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